No. 365.

FOURTH REPORT

ON

EARTHQUAKES IN JAMAICA.

On the Periods of the Shocks from the principal Jamaica Earthquake Centres

AND

Further Notes on the Great Earthquake, 1907, Jan. 14.

BY

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THE PERIODS OF THE SHOCKS FROM THE PRINCIPAL JAMAICA EARTHQUAKE CENTRES.

A few days after the light shock of Jan. 2 this year, a notice was sent to the press calling attention to the fact that the centre of the shock was deep seated, that its epicentre coincided with that of the great Earthquake of 1907 Jan. 14, and that its occurrence coincided with one of the 21 day periods of the after-shocks.

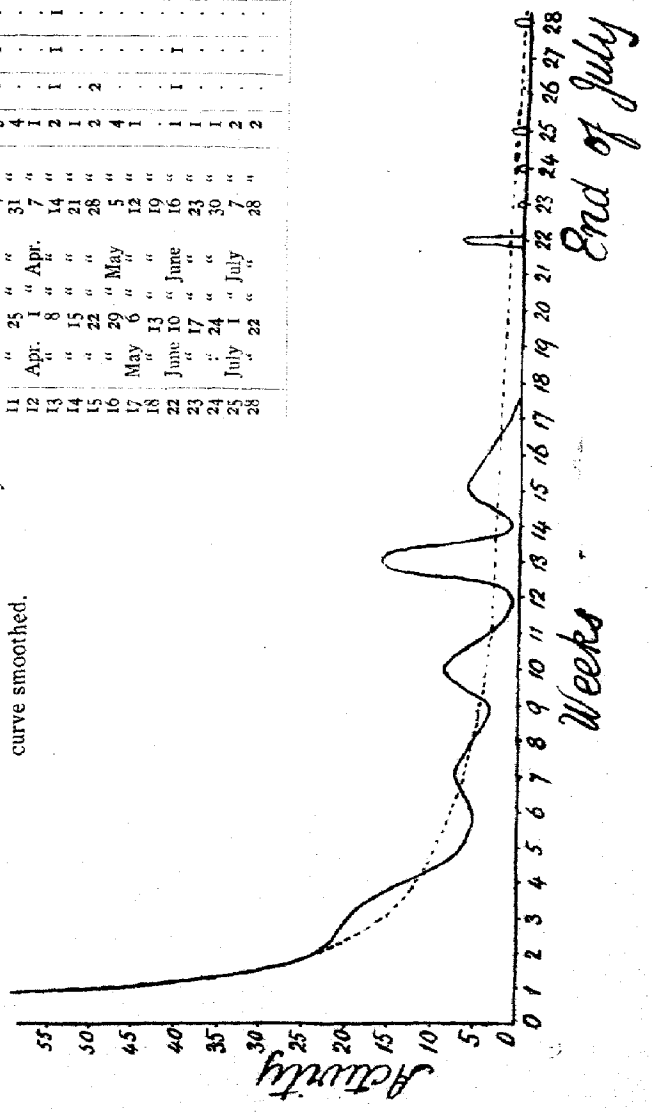
The after-shocks were grouped together by weeks, and a maximum was found to occur every three weeks; but we have now to consider isolated shocks so as to continue the investigation both forward and backward; and we shall replace the after-shocks by the rather severe shocks of 1907 Mar. 22, April 13, and June 13, which caused, or helped to cause, three of the maxima.

SHOCKS REGISTERED.

Week.	1907.	I.	II.	III.	IV.	Act.
1	Jan. 14 to Jan. 20 incl.	39	9	.	.	57
2	" 21 " 27 "	15	2	1	.	23
3	" 28 " Feb. 3 "	12	2	1	.	20
4	Feb. 4 " 10 "	9	2	.	.	13
5	" 11 " 17 "	1	1	1	.	7
6	" 18 " 24 "	2	.	1	.	6
7	" 25 " Mar. 3 "	8	.	.	.	8
8	Mar. 4 " 10 "	4	1	.	.	6
9	" 11 " 17 "	4	.	.	.	4
10	" 18 " 24 "	3	1	1	.	9
11	" 25 " 31 "	4	.	.	.	4
12	Apr. 1 " 7 "	1	.	.	.	1
13	" 8 " 14 "	2	1	1	1	16
14	" 15 " 21 "	1	.	.	.	1
15	" 22 " 28 "	2	2	.	.	6
16	" 29 " May 5 "	4	.	.	.	4
17	May 6 " 12 "	1	.	.	.	1
18	" 13 " 19 "	.	.	.	.	0
22	June 10 " 16 "	1	1	1	.	7
23	" 17 " 23 "	1	.	.	.	1
24	" 24 " 30 "	1	.	.	.	1
25	July 1 " 7 "	2	.	.	.	2
28	" 22 " 28 "	2	.	.	.	2

Activity curve of the After-shocks from Jan. 14th, 1907, onwards.

The dotted curve shows the activity-curve smoothed.



We thus have the following series: —

THE HISTORICAL EPICENTRE (H).

Intensity.	Date.	Intervals.	No. of periods.	Length of periods.	
		days.		d.	hr.
VI	1907 Jan. 14	67	3	22	8
III	" Mar. 22				
"	" " 22	22	1	22	0
IV	" Apr. 13				
"	" " 13	101	5	20	5
I	" July 23				
"	" " 23	123	6	20	12
"	" Nov. 23				
"	" " 23	22	1	22	0
"	" Dec. 15				
"	" " 15	44	2	22	0
"	1908 Jan. 28				
"	" " 28	61	3	20	8
"	" Mar. 29				
"	" " 29	46	2	23	0
II	" May 14				
"	" " 14	44	2	22	0
I	" June 27				
"	" " 27	41	2	20	12
II	" Aug. 7				
"	" " 7	23	1	23	0
I	" " 30				
"	" " 30	83	4	20	18
"	" Nov. 21				
"	" " 21	42	2	21	0
"	1909 Jan. 2				
"	" " 2	19	1	19	0
"	" " 21				
"	" " 21	44	2	22	0
"	" Mar. 6				
"	" " 6	23	1	23	0
"	" " 29				
		805	38	21	4

The average length of the period was therefore 21 days 4 hours between 1907 Jan. 14 and 1909 Mar. 29; and as the period may be as small as 19 days, and as large as 23 days, it appears that the shocks may occur 2 days sooner or later than a rigorous system would demand.

If we examine the register of shocks between 1880 and 1907, while we often find the same length of period from a small number of periods, yet we meet with long intervals of time containing a large number of periods. Now from the small numbers we feel assured that the period remains fairly constant; and then the large numbers may be ascertained as in the following table by merely assuming that there is no break in the series.

THE HISTORICAL EPICENTRE, (H).

Intensity.	Date.	Intervals.	No. of periods.	Length of periods.		
		days.		d.	hr.	min.
II	1880 July 16					
III	1881 Dec. 26	528	25	21	3	0
"	" " 26					
III	1884 Jan. 14	749	35	21	9	0
"	" " 14					
II	1886 Apr. 18	825	39	21	4	0
"	" " 18					
III	1888 Feb. 26	679	32	21	5	0
"	" " 26					
I	" July 2	127	6	21	4	0
"	" " 2					
II	1890 Oct. 30	850	40	21	6	0
"	" " 30					
III	1891 " 27	362	17	21	7	0
"	" " 27					
I	1892 Sep. 29	338	16	21	3	0
"	" " 29					
I	1897 Apr. 8	1,652	78	21	4	0
"	" " 8					
II	1900 July 23	1,201	57	21	2	0
"	" " 23					
III	1906 Nov. 13	2,304	109	21	3	18
"	" " 13					
VI	1607 Jan. 14	62	3	20	16	0
		9,677	457	21	4	12

The average length of the period was therefore 21 days 4 hours 12 minutes between 1880 July 16, and 1907 Jan. 14.

Looking back among the historical records, from the shorter periods we find that the length of the period was about 21 days 5 hours; but the intervals now become so large that the number of periods they contain must be uncertain; and the former process is here continued merely to show that apparently the whole series is continuous.

THE HISTORICAL EPICENTRE (H).

Intensity.	Date.	Intervals.	No. of periods.	Length of periods.		
		days.		d.	hr.	min.
I	1688 Feb. 19	1,570	74	21	5	0
VI	1692 June 7					
V	1771 Sep. 7	28,931	1,362	21	5	55
"	" " 3					
II	1780 Jan. 7	3,048	144	21	4	0
"	" " 3					
"	1781 Feb. 17	407	19	21	10	0
"	" " 7					
II	1799 Jan. 6	6,532	308	21	5	0
"	" " 17					
III	1801 Aug. 17	953	45	21	4	0
"	" " 6					
II	1802 Sep. 25	404	19	21	6	0
"	" " 17					
II	1812 July 6	3,572	168	21	6	0
"	" " 25					
IV	" Nov. 11	128	6	21	8	0
"	" " 6					
II	1880 July 16	24,719	1,166	21	4	48

Between 1771 Sept. 3 and 1812 Nov. 11, there is an interval of 15,044 days containing 709 periods, so that the average length of the period between these dates is 21 days 5 hours 15 minutes.

We thus get the following table:—

	Middle year.		Length of period.		
			d.	hr.	min.
1692 / 1771	1732	...	21	5	55
1771 / 1812	1791	...	21	5	15
1812 / 1880	1846	...	21	4	48
1880 / 1907	1894	...	21	4	12

from which it appears that the period is diminishing at the rate of about an hour every hundred years.

The epicentre of the above series of shocks lies below the sea some 10 or 20 miles south-east of Kingston, and we have called it the Historical epicentre (H) to distinguish it from the following epicentres marked (S) and (P) respectively.

The next epicentre we shall consider is that near Siloah and Accompong (S), at the northern boundary of the parish of St. Elizabeth; attention was called to this centre and epicentre by the strong shock of 1908 Jan. 2. We shall not have much difficulty in picking out these shocks; when we read in the Weather Reports that the shocks were felt between Windsor Pen, Trel., and Potsdam, or between Windsor Pen and Petersville, or between Unity Valley and Mt. Edgecombe, we may be pretty sure that they came from this centre.

THE EPICENTRE NEAR SILOAH AND ACCOMPONG (S).

Intensity.	Date.	Interval.	No. of periods.	Length of periods.
		days.		hr. min.
II	1872 Dec. 7	3,233	216	14 23
II	1881 Oct. 14			
"	" " 14	1,058	71	14 22
II	1884 Sept. 6			
"	" " 6	391	26	15 1
III	1885 Oct. 2			
"	" " 2	404	27	14 23
I	1886 Nov. 10			
"	" " 10	450	30	15 0
II	1888 Feb. 3			
"	" " 3	73	5	14 14
I	" Apr. 16			
"	" " 16	677	45	15 1
II	1890 Feb. 22			
"	" " 22	1,394	93	15 0
"	1893 Dec. 17			
"	" " 17	791	53	14 22
II	1896 Feb. 16			
"	" " 16	421	28	15 1
II	1897 Apr. 12			
"	" " 12	793	53	14 23
II	1899 June 14			
"	" " 14	984	66	14 22
II	1902 Feb. 23			
"	" " 23	209	14	14 22
"	" Sept. 20			
"	" " 20	327	22	14 21
"	1903 Aug. 13			
"	" " 13	32	2	16 0
I	" Sept. 14			
"	" " 14	501	33	15 4
II	1905 Jan. 27			
"	" " 27	511	34	15 1
II	1906 June 22			
"	" " 22	559	37	15 2
IV	1908 Jan. 2			
"	" " 2	119	8	14 21
I	" Apr. 30			
"	" " 30	123	8	15 9
"	" Aug. 31			
"	" " 31	163	11	14 19
"	1909 Feb. 10			
"	" " 10	17	1	17 0
	" " 27			
		13,230	883	15 0

The last of the three important centres is somewhere below the Port Royal Mountains (P), and apparently it is not as deep seated as the two former. In years past Dr. Manners kept a most valuable register at Abbey, about 4 miles east of Bull Bay; his register was discontinued in 1895; and very few shocks can be referred to this centre between 1895 and 1900, when they apparently cease. But the great earthquake of 1907 Jan. 14, from the Historical epicentre (H), at once revived the series (P), two of the shocks being of even No. III intensity.

Of course there is some difficulty in discriminating between the two series; and a number of variations may be made by modifying the list of shocks referred to (H) and (P); but such variations all tend to the same conclusions, namely, that the length of the period of the series (H) is between 21 days 4 hours and 21 days 5 hours, and that the series is continuous for at least considerable intervals of time; and that the length of the period of the series (P) is about 13 days, but that the series is not continuous.

Let us first consider the shocks after the great earthquake, commencing 1907 Feb. 17, as the h o cks before that date were too numerous.

THE EPICENTRE IN THE PORT ROYAL MOUNTAINS (P).

Intensity.	Date.	Intervals.	No. of periods.	Length of periods.	
		days.		d.	hr.
I	1907 Feb. 17	12	1	12	0
"	" Mar. 1				
"	" " 1	13	1	13	0
"	" " 14				
"	" " 14	13	1	13	0
"	" " 27				
III	" " 27	13	1	13	0
"	" Apr. 9				
III	" " 9	65	5	13	0
	" June 13				
		116	9	12	21
I	1907 July 1	27	2	13	12
"	" " 28				
II	" " 28	25	2	12	12
"	" Aug. 22				
I	" " 22	52	4	13	0
"	" Oct. 13				
"	" " 13	52	4	13	0
	" Dec. 4				
		156	12	13	0
I	1908 Feb. 23	26	2	13	0
"	" Mar. 20				
I	1908 Apr. 19	13	1	13	0
"	" May 2				
"	" " 2	51	4	12	18
"	" June 22				
"	" " 22	64	5	12	19
"	" Aug. 25				
"	" " 25	51	4	12	18
"	" Oct. 15				
"	" " 15	67	5	13	10
"	" Dec. 21				
"	" " 21	76	6	12	16
"	1909 Mar. 7				
		322	25	12	21

It will be noticed that the allowable error is about 1 day, or one-tenth of the period, as was the case with the series (H); and also that while the periods are remarkably regular in these sets, especially in the first three, yet they cannot be joined together without admitting large errors:—5 days between the first and second, 3 days between the second and third, and 4 days between the third and fourth. The sets are therefore not continuous.

The average length of the period is 12 days 22 hours.

For some years Professor Houzeau lived at Gordon Town, and he made notes of twelve shocks he felt there between the years 1870 and 1873: of these shocks nine apparently belong to the series (P); and it is interesting to notice that by assuming his series to be continuous we get exactly the same length of period.

THE EPICENTRE IN THE PORT ROYAL MOUNTAINS (P).
(Prof. Houzeau's series.)

Intensity.	Date.	Intervals.	No. of periods.	Length of periods.	
		days.		d.	hr.
I	1870 Feb. 3	563	43	13	2
"	1871 Aug. 20				
"	" " 20	77	6	12	20
"	" Nov. 5				
"	" " 5	28	2	14	0
"	" Dec. 3				
"	" " 3	242	19	12	18
"	1872 Aug. 1				
"	" " 1	214	17	12	14
"	1873 Mar. 3				
II	" " 3	118	9	13	3
"	"June " 29				
I	" " 29	52	4	13	0
"	" Aug. 20				
"	" " 20	37	3	12	8
	" Sept. 26				
		1,331	103	12	22

We now give the rest of the series from 1880 to 1900, for what it may be worth; they are to be considered as shocks probably belonging to the series; but the whole matter requires more attention than I can possibly give at present.

THE EPICENTRE IN THE PORT ROYAL MTS. (P.)

(Dr. Manners' series chiefly).

Intensity.	Date.			Intervals.	No. of periods.	Length of periods.	
				days.		d.	hr.
I	1880	Feb.	17	429	33	13	0
"	1881	Apr.	21				
"	"	"	21	74	6	12	8
"	"	July	4				
"	"	"	4	39	3	13	0
II	"	Aug.	12				
"	"	"	12	175	13	13	11
I	1882	Feb.	3		14	12	12
"	"	"	3	40	3	13	8
"	"	Mar.	15				
"	"	"	15	285	22	12	23
II	"	Dec.	25				
"	"	"	25	104	8	13	0
I	1883	Apr.	8				
"	"	"	8	227	17	13	8
"	"	Nov.	21		18	12	15
"	"	"	21	65	5	13	0
"	1884	Jan.	25				
"	"	"	25	189	14	13	12
II	"	Aug.	1		15	12	14
"	"	"	1	319	24	13	7
I	1885	June	16		25	12	18
"	"	"	16	75	6	12	12
III	"	Aug.	30				
"	"	"	30	124	10	12	10
II	1886	Jan.	1				
"	"	"	1	50	4	12	12
I	"	Feb.	20				
"	"	"	20	40	3	13	8
"	"	Apr.	1				
"	1886	Apr.	1	216	17	12	17
"	"	Nov.	3				
"	"	"	3	373	29	12	21
"	1887	"	11				
"	"	"	11	128	10	12	19
"	1888	Mar.	18				
"	"	"	18	423	33	12	19
II	1889	May	15				
"	"	"	15	37	3	12	8
III	"	June	21				
"	"	"	21	78	6	13	0
I	"	Sept.	7				
"	"	"	7	208	16	13	0
"	1890	Apr.	3				
"	"	"	3	49	4	12	6
"	"	May	22				
"	"	"	22	114	9	12	16
III	"	Sept.	13				
"	"	"	13	116	9	12	21
I	1891	Jan.	7				
"	"	"	7	40	3	13	8
"	"	Feb.	16				
"	"	"	16	304	23	13	5
"	"	Dec.	17		24	12	16
"	"	"	17	14	1	14	0
"	"	"	31				
"	"	"	31	102	8	12	18
"	1892	Apr.	11				
"	"	"	11	230	18	12	19
II	"	Nov.	27				
"	"	"	27	189	14	13	12
II	1893	June	4		15	12	14
"	"	"	4	79	6	13	4
"	"	Aug.	22				

Intensity.	Date.			Intervals.	No. of periods.	Length of periods.	
				days.		d.	hr.
II	1893	Aug.	22	362	28	12	22
I	1894	"	19				
"	"	"	19	283	22	12	21
"	1895	May	29				
"	"	"	29	125	10	12	12
"	"	Oct.	1				
"	"	"	1	771	60	12	20
"	1897	Nov.	10				
"	"	"	10	201	16	12	14
"	1898	May	30				
"	"	"	30	407	31	13	3
"	1899	July	11				
"	"	"	11	491	38	12	22
"	1900	Nov.	14				

Valuable registers are now being kept at Moy Hall, 3 miles south of the Blue Mountain reak; and at Mount Holstein, about 8 miles SSW of Buff Bay; such local registers are absolutely necessary as the shocks do not as a rule extend very far; but we miss the records from Abbey and Halberstadt.

A brief analysis of the register between 1880 and 1907 may be interesting; there are 194 shocks recorded, and 189 days on which shocks occurred; but 85 of these shocks could not possibly apply to the systems (H), (S), and (P); so that there are 104 days to be accounted for; (H) gives 13; (S) gives 17: and (P) gives 40; so that there are 34 sporadic shocks, or shocks which occur in an irregular manner, against 70 which are systematic. But further research will greatly reduce the number of the shocks we now call sporadic.

In order to aid such research the Register of Earthquakes given in Weather Report No. 337, p. 12, has been revised.

In part A, from 1688 to the commencement of the Weather Service, for 1844 May 31, read 1844 May 21; and to the date 1852 July 7, add 6.55 a.m.

The part B, from 1880 to the great Earthquake, has been re-written as carefully as possible so that the shocks may be traced to their centres; and the new part B is attached to the present article.

In part C, from the great Earthquake to the end of the After-shocks, for the intensity of the shock Mar. 5th, read II instead of I; and for Mar. 23rd insert another shock: 11.5 p.m. I. Mandeville. Also include the shocks at Moy Hall given in p. 12 of W. R. No. 337.

And of course there is now a fourth part D, containing shocks subsequent to the after-shocks up to date; and this part D is also attached to the present article.

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EARTHQUAKE REGISTER.

B.

From the commencement of the Weather Service in 1880 to the Great Earthquake, 1907 Jan. 14.

JAMAICA EARTHQUAKE SCALE.

I. Light shock.

II. Well marked shock.

III. Shock sufficient to make houses rock.

IV. " " " crack walls of houses.

V. " " " throw down a few houses.

VI. " " " " " almost all houses.

B.—*From 1880 to the Great Earthquake 1907 Jan. 14.*

Year.	Day.	Mean Time.	Intensity.	Notes: Where felt, &c.
		hr. min.		
1880	Feb. 17	11.25 a.m.	I	Kingston; Abbey; Buff Bay.
	July 16	10.25 p.m.	II	Whole Island.
	Oct. 15	7.30 a.m.	I	Kingston.
	Dec. 30	11.58 p.m.	IV	Port Antonio and whole Island except extreme west.
1881	Jan. 7	6.25 p.m.	I	Kingston and east of Island.
	" 8	10 a.m.	I	Kingston.
	April 21	7.40 a.m.	I	East of Island.
	July 4	3.30 p.m.	I	Kingston.
	Aug. 12	5.20 a.m.	II	Kingston, water rose 18 ins. in the harbour, 6 hrs. after shock.
	Aug. 13	7.35 p.m.	I	Kingston.
	Sep. 2	7.0 p.m.	I	Cinchona; Cedar Valley; St. George.
	Oct. 14	10.0 p.m.	II	Kepp.
	Nov. 4	2.30 p.m.	I	Abbey.
	Dec. 8	6.15 p.m.	I	Montego Bay, and St. James.
	" 26	11.48 p.m.	III	Kingston, and eastern end of Island.
1882	Jan. 22	6.0 a.m.	II	S. W. of St. Elizabeth.
	Feb. 3	2.0 a.m.	I	Kingston; Abbey.
	Mar. 2	4.20 a.m.	I	Annotto Bay; Cinchona.
	" 15	9.15 p.m.	I	Kingston.
	May 5	1.5 a.m.	II	Long Hill, St. Elizabeth.
	July 27	2.50 p.m.	II	Cinchona.
	Sept. 7	3.45 a.m.	II	St. Thomas.
	Sept. 20	4.40 p.m.	I	Roaring River, Westmoreland.
	Oct. 15	7.45 a.m.	I	Abbey.
	Dec. 25	9.0 p.m.	II	Abbey; Halberstadt.
	" 27	1.30 a.m.	I	Abbey.
	" 27	1.20 p.m.	I	Kingston.
1883	Feb. 1	10.27 p.m.	I	Sav.-la-Mar; Haughton Grove.
	April 8	11.5 a.m.	I	Kingston; Cinchona; Abbey.
	July 26	Early a.m.	I	Kingston.
	Oct. 15	11 a.m.	I	Mt. Sinai (close to Abbey).
	Nov. 21	8.22 a.m.	I	Cinchona; Abbey.
1884	Jan. 14	10.15 a.m.	I	Kingston.
	" 14	1.15 p.m.	III	Kingston and whole Island: only I at Montego Bay.
	" 25	3.45 a.m.	I	Kingston.
	" 29	2 p.m.	I	Kingston.
	Feb. 24	9.10 a.m.	II	Abbey.
	Aug. 1	6.30 a.m.	II	Abbey.
	Sept. 6	9.57 p.m.	II	West end of Island.
	Nov. 19	12.55 p.m.	I	Abbey.
	" 20	10.16 p.m.	I	Montego Bay.

B.—*From 1880 to the Great Earthquake, 1907 Jan. 14,* contd.

Year.	Day.	Mean Time.	Intensity.	Notes: Where felt, &c.
		hr. min.		
1885	Feb. 28	1.35 a.m.	II	Whole Island; double shocks; with sounds.
	June 16	7.30 a.m.	I	St. David.
	Aug. 30	7.15 p.m.	III	Halberstadt; whole Island. 33 sec.: double shock.
	Oct. 2	8.40 a.m.	III	Siloah and west end of Island.
	Dec. 14	7.15 p.m.	I	Montego Bay.
1886	Jan. 1	9.30 p.m.	II	Whole Island: strongest at Halberstadt.
	" 16	6.40 a.m.	I	Fontabelle, Westmoreland.
	" 20	midnight	I	Halberstadt.
	" 21	11.3 p.m	I	Abbey.
	" 22	midnight	I	Halberstadt.
	Feb. 9	3.50 p.m	III	Kepp to Petersfield, Westmoreland.
	" 20	6.50 p.m.	I	Kingston; Abbey; and Halberstadt.
	April 1	5.30 p.m.	I	Abbey.
	" 15	5 p.m.	I	Montego Bay.
	" 18	4.48 a.m.	II	Whole Island; loud sound.
	May 1	7.7 a.m.	III	Halberstadt; Abbey; Cinchona; I at Kingston.
	" 12	1.10 p.m.	III	do. do. do. do.
	" 12	2.10 p.m.	II	Halberstadt.
	" 14	11.42 a.m.	II	Halberstadt; Abbey; Cinchona; I at Kingston.
	" 28	3.15 p.m.	II	Montego Bay.
	June 3	7.7 p.m.	IV	Boston: III in Kingston; whole Island except extreme west.
	July 12	3 a.m.	I	Montego Bay.
	Nov. 3	8.10 p.m.	I	Cinchona.
	" 10	5.15 p.m.	I	Potsdam to Windsor Pen, Trel.
	" 15	1.20 a.m.	I	Potsdam.
	" 15	3.20 a.m.	I	Potsdam.
1887	April 18	2 a.m.	I	Montego Bay; Windsor Pen, Trel.
	Sept. 23	6.43 a.m.	III	Whole Island (W.R. No. 86) Great earthquake in Hayti.
	Nov. 11	1.30 p.m.	I	Abbey.
	" 16	4 a.m.	II	Annotto Bay.
	" 20	11.30 p.m.	I	Abbey.
1888	Feb. 3	4.40 a.m.	II	Whole Island. Light in Kingston; strongest at Potsdam and Unity Valley.
	" 26	9.16 p.m.	III	Whole Island. Strongest at Abbey and Boston. Explosive sounds.
	Mar. 18	4 a.m.	I	Kingston.
	April 14	1 p.m.	III	W. end of Island; strongest at Mt. Edgecombe.
	" 16	1.44 a.m.	I	Potsdam; Windsor Pen, Trel.
	July 2	3.42 a.m.	I	Kingston.
1889	Mar. 6	7.7 p.m.	II	Southfield, St. Ann.
	" 27	12.45 a.m.	II	Morant Point Light House.
	May 15	8 p.m.	II	Abbey.
	June 21	6.15 p.m.	III	Halberstadt; Abbey.

B.—*From 1880 to the Great Earthquake, 1907 Jan. 14,* contd.

Year.	Day.	Mean Time.	Intensity.	Notes: Where felt, &c.
		hr. min.		
1889	Sept. 7	5 a.m.	I	Abbey.
	" 7	9.13 a.m.	I	Kingston.
	" 14	midnight	I	Abbey.
	Nov. 23	2.35 p.m.	II	Belleisle, Westm.
1890	Feb. 22	1.45 a.m.	II	Potsdam.
	April 3	11.43 a.m.	I	Kingston.
	May 22	2 a.m.	I	Kingston; Shortwood; Abbey.
	Sept. 13	12.55 a.m.	III	Good Hope; Abbey.
	" 19	3.45 p.m.	II	Abbey.
	Oct. 30	8.15 p.m.	II	Kingston and east of Island.
	Nov. 11	2.10 p.m.	I	Shortwood College; Castleton.
1891	Jan. 7	5 a.m.	I	Abbey.
	" 27	6.30 a.m.	I	Kingston.
	" 28	7.30 a.m.	I	Abbey.
	Feb. 16	3 a.m.	I	Kingston.
	" 17	2.30 a.m.	I	Abbey.
	April 27	7.15 a.m.	II	Bethel Town; Montego Bay.
	May 20	6.30 a.m.	I	Bethel Town.
	Oct. 27	1.40 a.m.	III	Whole Island.
	Dec. 17	6.45 a.m.	I	Kingston; Bull Bay.
	" 31	2.50 p.m.	I	Abbey.
1892	April 11	4.30 a.m.	I	Abbey.
	Aug. 9	9.42 p.m.	III	Cinchona; Abbey; Burlington.*
	Sept. 29	5.30 a.m.	I	Abbey.
	" 29	5.50 p.m.	I	Kingston.
	" 29	6.45 p.m.	I	Abbey.
	Nov. 27	1.25 p.m.	II	Abbey.
1893	Feb. 19	1.35 a.m.	I	Kingston.
	June 2	7.45 p.m.	I	Kingston; Abbey; Cinchona.
	" 4	8.33 a.m.	II	Kingston; Abbey; Cinchona.
	Aug. 22	12.20 a.m.	II	Portland Gap to Halfway Tree.
	Dec. 17	4.20 a.m.	II	Western Favell; Windsor Pen, Trel.; Farm Pln.
1894	Feb. 4	9.35 p.m.	I	Windsor Pen, Trel.
	Mar. 20	1.45 a.m.	I	Windsor Pen, Trel.
	July 22	8 p.m.	I	Fontabelle, Westm.
	Aug. 19	1.20 a.m.	I	Shortwood, Ashleigh (nr. Gordon Town).
	" 31	2.30 a.m.	II	Potsdam; Peters Ville; Fontabelle, Wastm.
	Sept. 21	6.45 p.m.	I	Shortwood; Castleton.
	Oct. 25	2.7 a.m.	I	Potsdam.
	Nov. 19	5.50 p.m.	II	Mandeville.

* Near mouth of the Rio Grande.

B.—*From 1880 to the Great Earthquake, 1907 Jan. 14,* contd.

Year.	Day.	Mean Time.	Intensity.	Notes: Where felt, &c.
		hr. min		
1895	Feb. 11	5.24 p.m.	I	Albion, St. Ann.
	" 12	5.20 p.m.	I	Shortwood.
	April 14	4.25 a.m.	II	Whole Island, strongest at Brownsville.
	" 22	3 a.m.	I	Shortwood.
	" 28	8 p.m.	I	West Island; Strongest at Round Hill.
	" 30	4.45 a.m.	I	Whole Island: strongest at Potsdam.
	May 29	9.30 p.m.	I	Abbey.
	July 9	4 a.m.	I	Round Hill.
	Sept. 21	12.25 a.m.	I	Petersville.
	" 30	4.25 p.m.	I	Kingston; Shortwood; Albion, St. Ann.
	Oct. 1	12.30 a.m.	I	Abbey.
	" 1	3.30 a.m.	I	Abbey.
	" 1	3.30 p.m.	I	Abbey.
	" 2	11.30 p.m.	I	Yallahs Bay.
	" 3	3.15 a.m.	I	Albion, St. Ann.
	" 7	9 p.m.	I	Abbey.
1896	Jan. 2	6.30 p.m.	I	West of Island.
	" 28	10.30 p.m.	III	Whole of Island, strongest at Brownsville.
	Feb. 12	8.45 p.m.	I	Windsor Pen, Trel.; Brownsville; King's Valley.
	" 16	1.7 p.m.	II	Whole Island.
	" 18	2.55 a.m.	II	Moneague.
	July 29	10.45 p.m.	I	Halfway Tree.
	Dec. 24	10.30 p.m.	I	Long Hill.
1897	April 8	5.7 a.m.	I	Kingston.
	" 12	8.46 p.m.	II	Whole Island, strongest at Copse.
	Nov. 10	9 a.m.	I	Kingston.
	Dec. 14	7.40 a.m.	I	Kingston.
1898	Jan. 20	6 a.m.	I	Kingston.
	" 22	11.10 p.m.	I	Kingston.
	May 30	3.45 a.m.	I	Shortwood.
	July 10	9.55 p.m.	II	North-west of Island, strongest at Cinnamon Hill.
	Nov. 25	10 p.m.	I	Albion, St. Ann.
	Dec. 14	10.35 a.m.	II	Petersville; Mt. Edgecombe.
1899	Jan. 21	9.40 a.m.	II	Kingston; Spring Gard.; Unity Valley; Moneague.
	June 14	6 a.m.	II	Whole Island, strongest at Cinnamon Hill.
	July 11	2.45 p.m.	I	Kingston and Spanish Town.
1900	June 7	7.15 a.m.	I	Extreme west of Island.
	July 23	1.30 a.m.	II	Whole Island.
	Sept. 11	11.15 a.m.	I	Copse; Petersville.
	Nov. 6	8.30 a.m.	I	Castleton.
	" 6	8.50 p.m.	I	Castleton; Kingston.
	" 14	2.35 p.m.	I	East of Island.

B.—*From 1880 to the Great Earthquake, 1907 Jan. 14*, contd.

Year.	Day.	Mean Time.	Intensity.	Notes: Where felt, &c.
		hr. min.		
1901	Jan. 11	12.2 p.m.	I	Brownsville.
	Oct. 13	2.54 p.m.	I	Albion, St. Ann.
1902	Feb. 23	6.30 a.m.	II	Westend of Island; Windsor Pen to Petersville; strongest at Cinnamon Hill.
	" 23	9.35 p.m.	I	Cinnamon Hill.
	July 11	4.50 a.m.	I	Unity Valley.
	Sept. 20	7 p.m.	II	West of Island; from Unity Valley to Negril Pt. Light House,
	" 21	6.43 p.m.	I	Brownsville.
	" 21	7.20 p.m	I	Windsor Pen, Trelawny.
	Nov. 10	12.1 a.m.	I	Albion, St. Ann.
	" 13	5.20 a.m.	I	West of Island: from Brownsville to Petersville.
	" 22	3.0 a.m.	I	North-west of Island; from Albion to Petersville.
1903	Feb. 5	2.38 p.m.	I	Petersville.
	Aug. 2	2 a.m.	I	Little River.
	" 3	2.10 a.m.	I	Unity Valley.
	" 13	9.5 a.m.	I	S. W. of Island; from Mandeville to Mt. Edgecombe.
	" 16	8.40 a.m.	I	Unity Valley.
	Sept. 14	1.30 a.m.	II	Windsor Pen, Trelawny; Unity Valley.
	" 19	2.25 a.m.	I	Unity Valley.
1904	Nov. 25	10.35 a.m.	I	Middle of Island.
1905	Jan. 27	2.45 p.m.	II	From Unity Valley to Mt. Edgecombe.
1906	April 13	9.55 p.m.	I	Unity Valley.
	June 22	2.30 a.m.	II	Unity Valley to Windsor Pen, Trel.
	" 22	1.30 p.m.	II	Kingston.
	" 22	2 p.m.	II	Kingston.
	" 26	1.50 p.m.	I	Windsor Pen, Trel.
	Nov. 13	10.54 p.m.	III	Kingston.
	" 17	3 a.m.	I	King's Valley, Westm.
	" 24	3 a.m.	I	Bluefields do
	" 25	2.50 a.m.	I	Windsor Pen, Trel.
1907	Jan. 14	3.29 p.m.	VI	The great earthquake at Kingston, and whole Island.

EARTHQUAKE REGISTER.

D.

Shocks subsequent to the After-Shocks.

D.—*New Series subsequent to the After-shocks.*

Year.	Day.	Mean Time.	Intensity.	Notes: where felt, &c.
		hr. min.		
1907	July 23	8.11 a.m.	I	Kingston.
	" 28	4.30 a.m.	I	Kingston.
	Aug. 8	5.30 p.m.	I	Unity Valley.
	" 22	4.25 p.m.	II	Kingston, N. 85° E., 0.012, 3 sec. Moy Hall.
	" 28	10.30 p.m.	I	Kempshot Obs.
	Sept. 29	1.40 a.m.	I	Windsor Pen, Trel.
	Oct. 3	5.9 p.m.	II	St. Mary & St. Ann; Chapelton N.E., 0.002; Kingston N.E., 0.010.
	" 13	7.5 p.m.	I	Mt. Holstein.
	Nov. 19	11 p.m.	II	Chapelton, N. 35° E., 0.020.
	" 23	3 p.m.	I	Kingston, N. by E., 0.002.
	" "	8.8 p.m.	I	Chapelton.
	" 25	11.30 p.m.	I	Chapelton.
	" 29	12.20 a.m.	II	Chapelton. N. 27° W., 0.013.
	Dec. 1	11.30 p.m.	I	Brown's Town.
	" 2	5.45 a.m.	II	Chapelton, N. 76° E., 0.016. Savoy; Brown's Town.
	" 4	2.30 p.m.	I	Grange Hill, Westm.
	" "	9.10 p.m.	I	Kingston Harbour.
	" "	10.17 p.m.	I	Kingston Harbour.
	" 5	1.55 a.m.	I	Mt. Holstein.
	" 7	4.34 a.m.	I	Kingston; Moy Hall.
	" 9	1.55 p.m.	I	Mt. Holstein.
	" 10	early	I	Kingston, N. 45° W., 0.002.
	" 11	4 a.m.	I	Chapelton, N. 83° E., 0.002.
	" 13	3.40 p.m.	I	King's Valley, Westm.
	" 15	3.36 a.m.	I	Kingston, E. 0.002; Moy Hall.
	" 22	8.10 p.m.	I	Kingston, N., 0.002.
	" 25	8.40 p.m.	II	Mt. Holstein; I. Kingston, N. 11° W., 0.004; I. Moy Hall; Unity Valley: Kew Park.
	" 28	6 a.m.	I	Mandeville.
	" 31	5.10 p.m.	I	Brownsville.
	" "	9.30 a.m.	I	King's Valley.
1908	Jan. 2	8.9 a.m.	IV	Whole island; epicentre near Siloah and Accompong.
	" "	1 p.m.	I	Brownsville.
	" "	During night	I	Cinnamon Hill; Montego Bay; Windsor Pen: 2 shocks.
	" 3	5.59 p.m.	II	Chapelton N. 25° E., 0.010: I. Moy Hall; Unity Valley; Windsor Pen; Cinnamon Hill; Kempshot; Montego Bay; Negril Point L.H.
	" "	9.30 p.m.	I	Cinnamon Hill.
	" 4	11.25 a.m.	I	Kempshot.
	" 6	10.45 p.m.	II	Black River.
	" 8	2.10 a.m.	I	Black River; Sav.-la-Mar.
	" "	11.3 a.m.	II	Black River; Windsor Pen.
	" 10	1.25 p.m.	I	Chapelton.
	" 11	2.15 p.m.	II	Unity Valley.

D.—*Shocks subsequent to the After-shocks*, contd.

Year.	Day.	Mean time.	Intensity.	Notes: Where felt, &c.
		hr. min.		
1908	Jan. 12	3.40 p.m.	I	Chapelton.
	" 13	11.30 p.m.	I	Fontabelle, Westm.
	" 16	8 a.m.	I	Mt. Holstein
	" 17	6 p.m.	II	Fontabelle, Westm.
	" 19	9 p.m.	I	Chapelton, N 60° E, 0·002.
	" 21	8.28 a.m.	I	Negril Pt. L. H. N 10° E, 0·020.
	" "	11 p.m.	I	Mt. Holstein; prolonged sound.
	" 22	10.39 p.m.	I	Kingston, N 10° E, 0·002.
	" 28	3.55 a.m.	I	do. N 112° E, 0·003.
	Feb. 1	10.15 p.m.	I	do. N 11° E, 0·004: Savoy.
	" 2	Early	I	Savoy.
	" 4	Day time	II	Negril, NW, 0·013.
	" 6	12.55 p.m.	II	Denbigh, Suttons, Danks: only sound at Chapelton, Savoy, Claremont
	" 7	11.5 a.m.	IV	Golden Grove, Bath, Manchioneal: I at Port Antonio: loud sound.
	" 12	12.30 a.m.	II	Halfway Tree.
	" "	1.30 a.m.	I	do two shocks.
	" 23	6.20 p.m.	I	Mt. Holstein: double shock from SW, with twisting movement.
	" 24	1.9 p.m.	II	Mt. Holstein: double shock from S: also at Clonmel.
	Mar. 2	3.19 p.m.	II	Mt. Holstein: I Kingston, ENE, 0·006, 4 sec. Moy Hall. But at Kellitts it was II: at Unity Valley only sound.
	" 3	4.45 p.m.		Kings Valley: sound, 3 secs.
	" "	4.46 p.m.	II	do. lound sound, 10 sec.
	" 5	2.15 a.m.	I	Moy Hall.
	" 19	2.30 a.m.	I	Mt. Holstein
	" 20	0.40 a.m.	I	do.
	" 21	9.15 p.m.	I	Negril.
	" 24	10.45 p.m.	I	Kings Valley.
	" 29	1.9 a.m.	I	Kingston, N, 0·002: Mt. Holstein: Moy Hal
	" "	1.56 a.m.	I	Chapelton, N 22° W, 0·003.
	April 1	Prev. night	I	Kings Valley, WNW.
	" 11	do.	I	Chapelton.
	" 17	8.30 a.m.	I	Danks.
	" 19	1.5 a.m.	I	Mt. Holstein.
	" "	Prev. night	I	King's Valley, WNW.
	" 26	7.45 p.m.	I	Kingston, E, 0·002.
	" 30	10.30 a.m.	I	Mt. Holstein.
	" "	noon	I	Siloah.
	" "	1 p.m.	I	do. Sound.
	May 2	1.30 p.m.	I	Mt. Holstein.
	" 14	10.46 a.m.	II	Kingston, N, 0·006, 2 sec. Chapelton, NW, 0·003. Mt. Holstein. Moy Hall; Savoy.
	" 26	7.15 p.m.	I	Negril, sound.

D.—*Shocks subsequent to the After-shocks*, contd.

Year.	Day.	Mean Time.	Intensity.	Notes: where felt, &c.
		hr. min.		
1908	June 2	4.30 a.m.	I	Brownsville.
	" 5	1.4 p.m.	I	Falmouth; Windsor Pen, Trel.
	" 17	4.55 a.m.	I	Mt. Holstein: sound.
	" 22	4.30 p.m.	I	Mt. Holstein: sound.
	" 27	4.40 p.m.	I	Kingston: sound.
	" 28	2.30 a.m.	I	Windsor Pen, Trel.
	Aug. 1	5.0 a.m.	I	Falmouth.
	" 3	1.20 a.m.	I	Mt. Holstein; from S.
	" "	3.30 p.m.	II	Great Valley, Han., N.E., 0.012.
	" 7*	9.10 a.m.	II	Mt. Holstein, S.E., sound; I. at Kingston from N.E.; Gordon Town; Moy Hall.
	" 25	8.0 p.m.	I	Mount Holstein; prolonged.
	" 30	4.0 a.m.	I	Kingston, S.E., 0.003.
	" 31	10.40 p.m.	I	Siloah.
	Sept. 14	5.45 a.m.	I	Moy Hall, double shock; Mt. Holstein, single shock; Port Antonio; Kingston.
	" "	8.16 a.m.	II	Mt. Holstein, sound; I. Kingston; Green Vale, Port.; Port Antonio.
	" 28	9.0 p.m.	I	Crooked River, Upper Clarendon.
	" 29	5.21 a.m.	II	Albion, St. Ann.
	Oct. 7	3.0 a.m.	I	Mt. Holstein.
	" 12	4.35 a.m.	I	Mt. Holstein, prolonged; sound.
	" 15	12.4 a.m.	I	Mt. Holstein; Kingston.
	" 19	2.0 p.m.	I	King's Valley.
	" 26	5.30 p.m.	I	Mt. Holstein, N., 0.007.
	Nov. 3	1.0 p.m.	I	Mt. Holstein.
	" 6	10.15 p.m.	II	Mt. Holstein: sound. I. Kingston, N. 37° E.; Moy Hall.
	" 21	1.0 a.m.	I	Kingston, N.
	Dec. 21	3.0 a.m.	I	Mt. Holstein, E. & W.
	" 24	3.0 a.m.	I	Mt. Holstein, E. & W.; sound.
1909	Jan. 2	10.5 a.m.	I	East end of island, from Moy Hall to Mandeville. At Kingston, S. 40° E., 4 sec.; at Chapelton S. 45° E.; at Mt. Holstein, S. or S.E., double. Also felt at Siloah? Good deal of sound everywhere.
	" "	11.5 a.m.	I	Savoy, S.E.
	" "	3.23 p.m.	I	Savoy, S.E.
	" 7	2.45 p.m.	II	Negril Pt. L. H., N. 25° E.
	" 21	1.3 p.m.	I	Kingston, S. 30° E, 3 sec.
	" 23	9.30 a.m.	I	Glasgow, Westm.
	" 30	6.45 a.m.	I	Unity Valley; three light shocks in succession.
	" "	2.30 p.m.	I	King's Valley.
	" 31	11.45 a.m.	II	Brownsville, Han. Also felt at Great Valley, Mt. Edgecombe, Cinnamon Hill, and Windsor Pen.
	" "	12.15 p.m.	I	Unity Valley.
	" "	9 p.m.	I	Grange Hill.
	Feb. 1	4.15 a.m.	III	Smithville, N.W. Clarendon; also I. at Mandeville, Shickles, May Pen, and Rhymesbury.
	" "	7.0 a.m.	I	Great Valley, Han.

D.—*Shocks subsequent to the After-shocks,* contd.

Year.	Day.	Mean Time.	Intensity.	Notes: Where felt, &c.
		hr. min.		
1909	Feb. 2	9.55 a.m.	I	Mt. Holstein: sound.
	" 10	1.49 a.m.	I	Halfway Tree.
	" 10	11.30 p.m.	III	Siloah; Windsor Pen. II at Mt. Edgecombe, King's Valley, Great Valley, and Brownsville.
	" 27	5.20 a.m.	I	Siloah; Mt. Edgecombe.
	Mar. 2	3.50 a.m.	I	Kingston, SE. 0.004; Moy Hall; Mt. Holstein.
	" 6	3.15 a.m.	I	Kingston; SE. 0.002; Mt. Holstein.
	" 7	3.15 a.m.	II	Halfway Tree, sound; I Mt. Holstein; very light in Kingston.
	" 7	9.0 a.m.	I	Mt. Holstein.
	" 15	night	I	Great Valley, E.
	" 16	3.15 p.m.	I	Great Valley, ESE.
	" 29	5.30 a.m.	I	Kingston, SE. 0.002, 2 sec.
	Apr. 18	7.25 p.m.	I	Mt. Holstein.
	May ...	...	I	Great Valley, between 14th and 17th.
	" 19	8.5 a.m.	II	Mt. Edgecombe; Petersville; Black River; Malvern.
	" 23	1 a.m.	I	King's Valley.
	" 29	5.6 a.m.	I	Kingston; Mt. Holstein.

THE DISTURBANCE OF THE BED OF THE SEA AT THE EPICENTRE OF THE EARTHQUAKE, 1907 JANUARY 14.

The cable belonging to the Direct W. I. Cable Co., comes ashore at Bull Bay ; and the Jamaica to Colon section of the W. I. & P. Telegraph Co., also comes ashore at the same place, as is shown in the small plan attached to this notice.

From information supplied by Mr. R. Sullivan, the Superintendent of the Direct Cable Co. in Jamaica, it appears that for some 15 miles south and east of Bull Bay, the cable was "pulled, crushed, torn and twisted; in some places the cable was deeply buried and could hardly be lifted; but some sections, nearly a mile long, were, however, in as good condition as when laid."

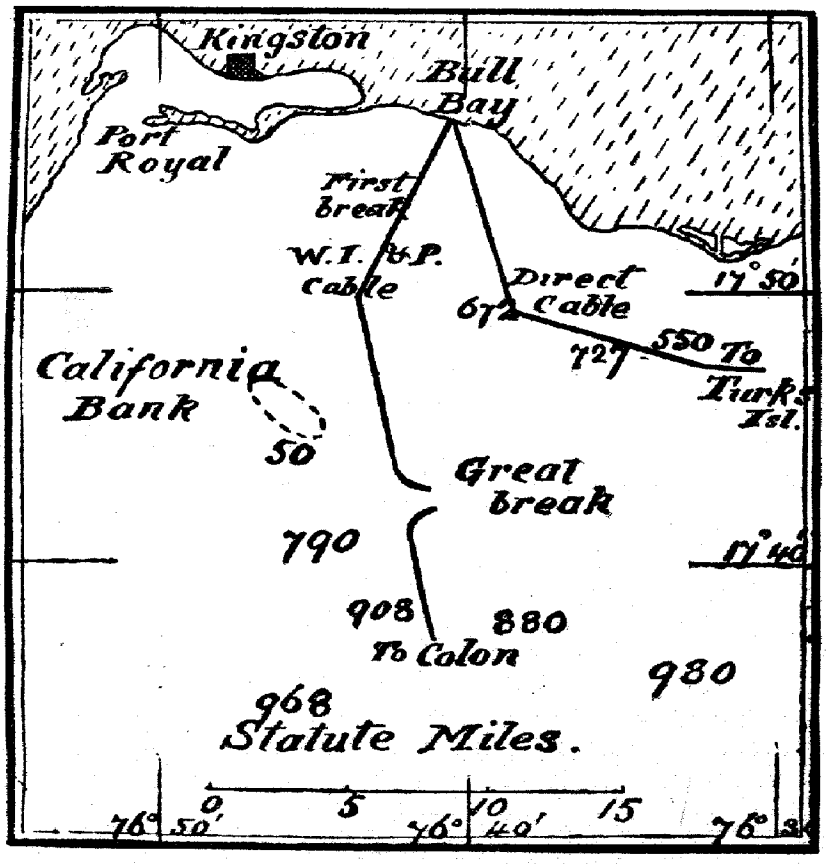
With reference to the other cable belonging to the W. I. and P. Telegraph Co., Captain Morrell of the repairing S.S. "Henry Holmes" wrote that the first break on the Jamaica to Colon cable occurred 4 miles or so south of Bull Bay ; and that on testing again, another break was found 20 or 25 miles south of Bull Bay.

On attempting to raise the cable south of the first break, it was found deeply buried in mud and parted at a strain of five tons.

Proceeding to the place of the second break, the two ends of the cable were found fully one mile apart, the cable having been dragged from west to east.

Captain Morrell wrote :—"There is no doubt, that these two ends coincide, as they fitted together exactly. The cable at the position of the break was excellent, and it was evidently broken by a tremendous strain as the wires at the break were broken clean, and there were no signs of erosion at all. I am certain by the lay of the cable, and the distance the ends were apart from one another, there must have been a landslide from the direction of the shallow water to deeper water."

Further south of this great break the cable was again deeply buried and had to be abandoned.



In the plan the soundings are given in fathoms; and it will be noticed that from the California Bank southwards the gradient is as large as 740 fathoms in about 5 miles, or 1 in 6 when reduced to the same units of measurement; this is large enough to produce land slides at the bottom of the sea; but where the great break occurred the bed of the sea is apparently level, or

nearly so; consequently the dragging of the cable for a mile or so to the east, and the parting of the ends when broken to the same extent could only have been produced by a great chasm opening in the bed of the sea to the east of the great break.

At any rate the bed of the sea was violently disturbed within the area comprised in the plan; and it is greatly to be desired that fresh soundings should be taken to show what changes, if any, have occurred. Captain Morrell has been far too fully occupied to take fresh soundings: perhaps the Admiralty could assist us.

THE DEPTH OF THE CENTRAL DISTURBANCE BELOW THE SURFACE OF THE EARTH.

The Earthquake scale adopted in the Report on the Great Earthquake of 1907 January 14th, W. R., No. 337, seems very suitable for Jamaica; but small corrections should be applied to the horizontal motions given on p. 22. Thus for No. I, the motion should be 0.003 instead of 0.004; and the ratio to be adopted is 3.162* instead of 3; so that we get the following table giving observed and deduced motions:—

Earthquake Scale.	Horizontal Motion.
	in.
I.	0.003
II.	0.010
III.	0.032
IV.	0.100
V.	0.316
VI.	1.000

In the map of the Island of Jamaica given in that Report, p 11, we now know that the ellipse bounding shocks of No. VI. intensity should be extended much further to the south: so that instead of any circular epicentres as there marked, we have to deal with a narrow band or line of greatest intensity, passing from Enfield to the margin of the map at longitude 76° 38′, and still further south; and distances near area VI. should be measured from this line.

Thus from this line to belt V, we have 18 miles; to belt IV, 39 miles (Chapelton); and to belt III, 85 miles; so that the ratio should be rather more than 2, instead of 2 as suggested in that Report. Now as Kingston, where the horizontal vibrations of 1 inch were observed, is 8 miles from this line, we have the following table giving observed and deduced motions and distances:—

Scale No.	Motion.	Distances.	Constant.
	inches.	miles.	k
I.	0.003	380	23.4
II.	0.010	175	23.2
III.	0.032	85	24.8
IV.	0.100	39	24.4
V.	0.316	18	24.2
VI.	1.000	8	...

Now we would have expected that the motion would have decreased inversely as the square of the distance from the central disturbance: but other writers say that it may decrease inversely as the distance; and it so happens that the figures above show that for this particular earthquake, the decrease was exactly between the two.

Let m be the amplitude of the horizontal motion of the surface of the earth at any place, measured in inches, or in decimals of an inch; and let n be the vertical motion; then the whole motion will be $(m^2 + n^2)^{\frac{1}{2}}$; and if r be the distance of the place from the centre, or central line, and k be a constant for the particular earthquake in question, then we have the equation

$$(m^2 + n^2)^{\frac{1}{2}} = \frac{k}{r^{\frac{1}{2}}}$$

But if d be the distance of the place from the epicentre, or epicentral line, and if z be the distance of the centre or central line below the surface, then

$$r^2 = d^2 + z^2 ,$$

so that

$$(m^2 + n^2)^{\frac{1}{2}} \times (d^2 + z^2)^{\frac{1}{2}} = k.$$

When d is large, both z and n may be neglected, and then

$$m\, d^{\frac{3}{2}} = k ;$$

and for small values of d,

$$\frac{m}{d}(d^2 + z^2)^{\frac{5}{4}} = k.$$

The different values of k are given in the last column of the above table; and adopting 24 as the value of k, from VI. we find that z was somewhat less than 2 miles.

* The logarithm is 0.5: and the table now reminds us of the one connecting the light and magnitude of stars.

I believe that this article brings the earthquake of 1907 January 14, more into line with other earthquakes studied elsewhere; but in connection with the very small depth of the central disturbance, I would remind my readers that the motion of the sea at Port Maria showed that the earth was heaving before the shock, so that the cause of the opening of the fissure in the sea 50 miles SSE of Port Maria may have been very deep seated.

If we consider the Siloah earthquake of 1908 January 2, a No. III shock was felt at 70 miles from the epicentre; and a No. IV. shock was felt at 18 miles from the epicentre, and all around it: whence $z = 20$ miles; and this great depth accounts for its having been felt fairly uniformly over the whole Island.

ADDITIONAL NOTES.

As this number of the Weather Reports has revised certain parts of the former Report No. 337, and extended others, it seems advisable to consider the whole Report, so as to bring it up to date, as it were; but the only further notes I have to make are:

(1.) That a very large number of the after-shocks, pp. 16, 17, 18, were recorded by Prof. Milne's instruments at Shide in the Isle of Wight; that for the most part they were all of only No. I intensity, and therefore probably deep seated; and that they took 43 minutes to travel from Jamaica to Shide: and that

(2.) With regard to the grouping of the after-shocks on p. 23, there is no doubt that the great shock opened out a number of small centres, most of which have since closed; that it seemed proper to search for them among the geological faults; that with the exception of the fault near Great Valley in Hanover, I see little or no connection between shocks and faults; and that with regard to the third set, instead of referring it to the fault near Spanish River, it should be referred to the centre, or one of the centres, in the Blue Mountains east of Catherine's Peak.

The following additional notes may be of interest.

The cessation of the after-shocks was well-marked; they stopped at the end of July, 1907, as was foreseen by means of the earthquake curve some two or three months previously; and during the following August only a few local shocks were felt over the Island. The new series has the following characteristics:—In a small locality two or three small shocks are felt within a day or two, and then the shocks are transferred to a far distant locality, and so on.

A very interesting article on the Jamaica Earthquake, with good illustrations, appeared in the Popular Science Monthly, May 1907, by Prof. Brown, of Brown University, Providence, R.I. The photographs of the fissures in the sand of the Palisadoes, p. 398, are particularly valuable; the fissures are referred to in W. R. No. 337, p. 3.

An important paper was read by Dr. Vaughan Cornish before the Royal Geographical Society in London, December 19th, 1907, which subsequently appeared in the Geographical Journal for March 1908; by working in Kingston and by a journey to Buff Bay, Dr. Cornish secured a large amount of information which he discussed in a most scientific manner.

In W. R., No. 349, the important earthquake of 1908, January 2, was carefully considered, and several important results were arrived at; we shall conclude the present article by reproducing those results without further comment.

" 1) From these two accounts at Cinnamon Hill and Black River, it would appear that there was about the same intensity at the two places, but that the shock came from opposite directions; so that we feel inclined to place the epicentre somewhere between them: at Ipswich for instance, or anywhere in the Cockpit country. And from what follows it appears that if an oval be drawn on the map of Jamaica through Ipswich, Accompong, and Siloah, it will fairly represent the epicentre; and that if a curved line be drawn through Runaway Bay, Crofts Hill and Milk River, it will divide the Island into two parts, the shock being of No. III intensity in the eastern part, and of No. IV intensity in the western part. At the epicentre it was probably between No. IV and V.

At Chapelton there were tremors for 3½ seconds, then there was a pause for 1½ seconds, then tremors again for 5 seconds, and finally undulations for 5 seconds, making altogether 15 seconds. There was no doubt about the undulations; they could be seen as well as felt: and the water in a large iron tank was dashed from side to side. The shock was said to have come from the E.

The duplex seismometer separated out three kinds of motion; the first consisted of several trembling vorticose movements round the vertical; the second was a clear well-marked shock N 50° E, with a horizontal ground movement of 0.077 inch., which corresponds to a scale shock between Nos. III and IV; and the third set consisted of waving lines N 10° E at least 4 inches in length on the plate, such as have never been recorded before as far as I am aware. These long lines were without doubt due to the undulation of the ground which made the two pendulums swing; and the duplex principle produced fairly straight lines.

The Kingston dead-beat seismometer gave a wonderfully tangled record; this may have been due to the instrument, or to its attachment to a wall, or to both: the result is that it is diffi-

cult to make out the general direction. Mr. Brennan chose S E and N W as shown by the longest diameter of the whole tangled figure. But it will be noticed that there are several fairly straight lines on the right and left hand of the figure; and these we shall consider to be the representatives of the undulations N 10° E of the Chapelton seismometer, having very much the same direction.

Again, if we hold the print at a considerable distance, it will be seen that the tracing at the centre form a patch nearly half an inch long pointing N E and S W. which may or may not correspond with the N 50° NE of the Chapelton seismometer.

(2) Now if the directions of the shock at the different places be drawn on the map, and if lines be drawn from the epicentre to the places, it will be found that the directions are not at right angles to the lines as was the case in the earthquake of January 14, 1907, but that they are at an angle of 45° to the lines: so that if a place were due north of the epicentre, as Cinnamon Hill for instance, the direction would be N W and S E.

Cinnamon Hill, Black River, Appleton, Mount Edgecombe, Negril, Brownsville, Montego Bay, Phœnix, Chapelton N 50° E, and Kingston, from my point of view, all agree with the above rule; but Linstead and Mount Holstein do not; they form exceptions.

(3) Again, in the *Report* it was stated at p. 12 that I found it difficut to understand why shocks N and S for instance, were often described as from S to N, or N to S, as the case might be; the same thing occurs in the descriptions given above; and at Cinnamon Hill, Black River, Appleton, Mount Edgcomb, and Phœnix, the emphasized motion was from left to right and towards the epicentre. But at Cinnamon Hill the sound and the emphasized motion were both from the same direction, namely N W; and by considering other cases in the two earthquakes I am inclined to think that it is the sound which emphasizes the motion. So that when the motion is said to be from N E to S W, we are to understand that the vibrations were N E and S W, and that the sound came from the N E, as at Annotto Bay, January 14th, 1907.

(4) The next matter for consideration is that the sound at any place seems to come from a direction more or less opposite to the epicentre. Thus in January 14th, 1907, the sound at Blue Mountain Valley was from the N E; at Annotto Bay the same: at Cinnamon Hill from the N: and at Kempshot from N W, and at Kingston the after-shocks that night were from the N W and at Buff Bay on the 15th from the sea, or N. Again on January 2nd, 1908, we have the sound at Cinnamon Hill and Kings Valley from the N W, and at Chapelton from the E.

But Brownsville proves an exception to this rule although it confirms the last but one.

(5) Lastly, the No. VI shock in 1907, set the motion at any place at right angles to the line joining the place and the epicentre; the No. IV shock in 1908, set the motion at any place at an angle of 45° to the line; it was assumed in the *Report* pp. 23, 24, that shocks of No. III intensity and under would be along the line; and nothing has occurred since then to show that the assumption was incorrect."

MAXWELL HALL,
Govt. Meteorologist.

Chapelton, May 29th, 1909.